Offshore wind resource mapping combining satellite winds and mesoscale modeling

Hasager, Charlotte Bay; Badger, Merete; Badger, Jake; Bingöl, Ferhat; Nielsen, Morten; Karagali, Ioanna; Hahmann, Andrea N.

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Technical University of Denmark DTU

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C.Hasager, M.Badger, J. Badger, F. Bingöl, M. Nielsen, I. Karagali, A. Hahmann

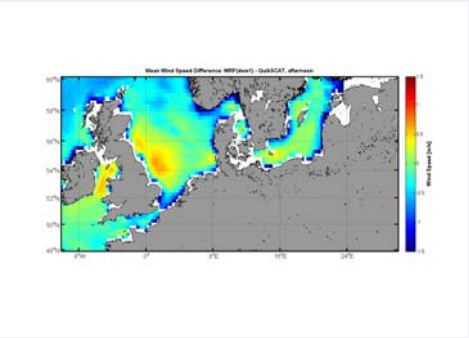
Risø DTU, Denmark

Abstract

A key challenge for mapping offshore wind resources is to obtain observations. Meteorological masts are costly and therefore sparse. Furthermore, data policy can prohibit exchange of wind information. In view of this, satellite-based wind retrieval is an alternative. The method developed by Risoe DTU on using a combination of high-resolution satellite wind maps and mesoscale modeling is new. We provide a blend from the numerical wind atlas method and the observational wind atlas method. Satellites carrying Synthetic Aperture Radar (SAR) are used to map ocean winds at a spatial resolution at 1 km by 1 km grid 10 m above sea level. Thus the satellite-based results are available at higher spatial resolution than mesoscale, whereas the mesoscale has the advantage of providing results at several levels. Also satellite winds from scatterometer are compared to mesoscale model results.

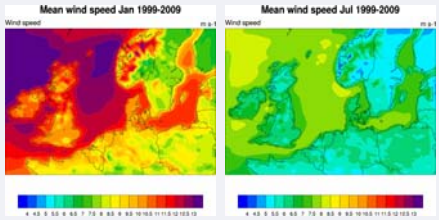
Scatterometer *vs.* WRF wind results

The scatterometer winds from QuikSCAT are compared to WRF mesoscale model results. Here shown the difference between WRF-QuikSCAT in the afternoon.



WRF *vs.* mast data wind results

Selected scenarios are modeled by mesoscale wind resource version of the WRF model (Weather Research and Forecast Model). The maps below are from an 11-year downscaling for 1999-2009, with two domains, 45 km and a nest at 15 km. The boundary conditions are from NCAR/NCEP reanalysis II, and the increased resolution SSTs 1/4 degree.



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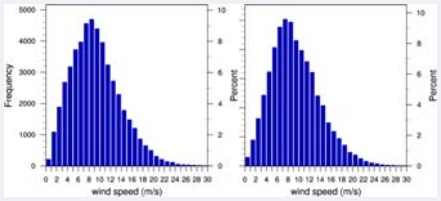
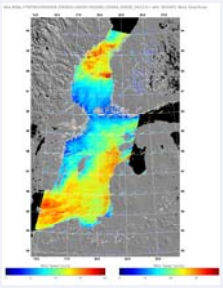
Seasonal variability.



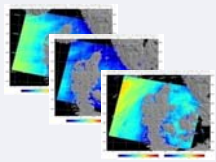
Preliminary validation. Comparing wind speed at 100 m at Høvsøre (left) and WRF (right) in years 2004-2009.

Wind class method: SAR-based *vs.* mast data



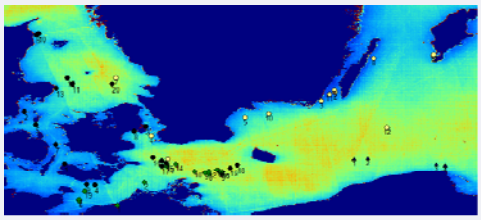
Envisat ASAR wind speed map.

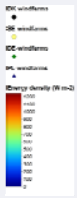
Wind class definition from NCEP/NCAR re-analysis data



Population of each wind class with a SAR wind field

SAR-based energy density

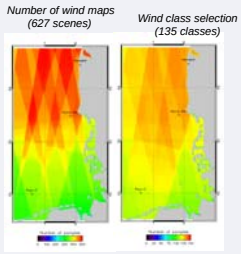




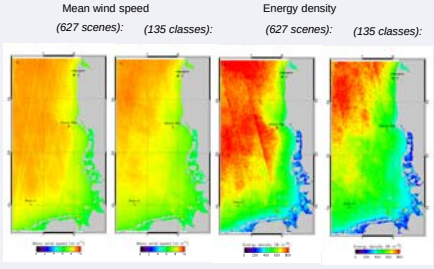
Energy density with existing and planned wind farms in the South Baltic Sea

Comparing to three masts:

- FINO-1. Courtesy BMU
- Horns Rev (mast 7), Courtesy DONG Energy
- Høvsøre (using WAsP). Courtesy RISØ DTU



	Mean Error	Mean Absolute Error
U (m s^{-1})	-1.8	2.2
A (m s^{-1})	-2.0	2.4
k	-3.7	3.7
E (W m^{-2})	-2.3	3.5



Conclusions

Work in progress on satelite wind mapping and WRF wind modelling in the North Sea and Baltic Sea.

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JHU/APL: APL/NOAA ANSWRS.